

ORBIT TRANSVERSE IMPEDANCE MODULE BENCHMARK – COMPARISON WITH ANALYTIC CALCULATION

**Transverse impedance module developed for ORBIT Code
(Slava Danilov, John Galambos, Jeff Holmes).**

Benchmark ORBIT with analytic calculation:

Straight uniform focusing lattice

Periodic length 248 m, tunes (6.4,6.3).

Localized vertical impedance

**$b/a = 2$, first harmonic ($Z = 10^6$ Ohm in detailed
results shown here).**

Coasting “pencil” beam with

1 mm displacement in y (0 harmonic);

**Lorentz energy distribution (1 GeV, RMS width 1%,
cutoff at 10%);**

10^{14} particles.

Use $2 \cdot 10^5$ macroparticles.

**Analytic calculation with Vlasov equation and Landau
damping.**

Results:

Instability threshold at 1.6 Mohm, within 5% agreement.

Halo can grow even for “stable” cases. This is found both analytically and computationally, and the results of the two approaches are in good agreement, as shown below.

These results neglect direct space charge forces.

Next step:

Develop 3-D space charge solver in ORBIT.

Collaborate with BNL (Andrei Shishlo and Nikolay Malitsky to implement impedance and space charge models in UAL.

TRANSVERSE IMPEDANCE: HALO GROWTH IN STABLE BEAMS

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